

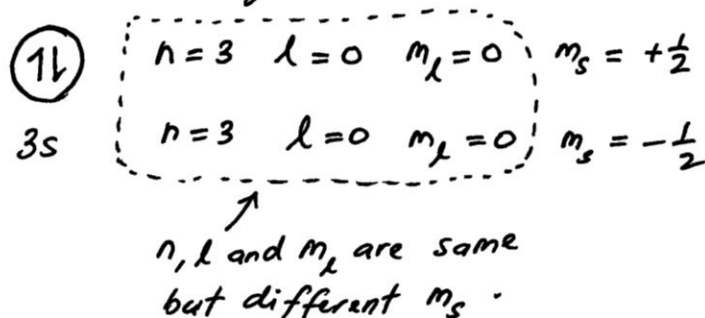
d) Spin Orientation Quantum Number

• An electron has magnetism associated with a property called spin. Magnetism is directional, so the spin of an electron is directional, too. Spin orientation is quantized; Electron spin must be oriented in one of 2 ways, label "up" or "down". The two possible values of m_s are $+\frac{1}{2}$ (up) and $-\frac{1}{2}$ (down)

• Electrons are said to be paired when they are in the same orbital (eg. $2s, 2p_x, 2p_y, 2p_z, 3d_{xy}, 3d_{xz}, \dots$) and have opposite spins - one has an $m_s = +\frac{1}{2}$ and the other has $m_s = -\frac{1}{2}$.

* Pauli Exclusion Principle - "No more than two electrons can be assigned to the same orbital in an atom, and these electrons must have opposite spins".

OR. "No two electrons in the same atom can have the same set of four quantum numbers n, l, m_l and m_s "



Problem-Solved Example 30

Give sets of four quantum numbers for three electrons that are

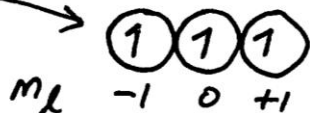
- in the same level, same sublevel, but in different orbitals .
- in the same level, but in different sublevels and in different orbitals .

Solution



Solution: a) level: $n = 2$ } different orbitals
 sublevel: $l = 1$ (p) } $2p_x, 2p_y, 2p_z$

three electrons →

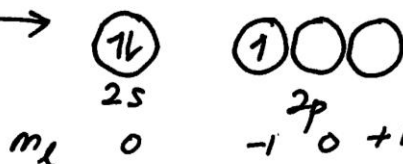


$n = 2 \quad l = 1 \quad m_l = -1 \quad m_s = -\frac{1}{2}$
 $n = 2 \quad l = 1 \quad m_l = 0 \quad m_s = -\frac{1}{2}$
 $n = 2 \quad l = 1 \quad m_l = +1 \quad m_s = -\frac{1}{2}$

(b) - same level } $n = 2$
 - different sublevel } $l = 0$ (s sublevel)
 } $l = 1$ (p sublevel)

- different orbitals: $2s, 2p_x, 2p_y, 2p_z$

3 electrons →



2s orbital: $n = 2 \quad l = 0 \quad m_l = 0 \quad m_s = -\frac{1}{2}$

$n = 2 \quad l = 0 \quad m_l = 0 \quad m_s = +\frac{1}{2}$

2p orbital: $n = 2 \quad l = 1 \quad m_l = -1 \quad m_s = -\frac{1}{2}$